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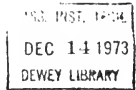
"DECISION SUPPORT SYSTEMS: THE DESIGN PROCESS"

By

Michael S. Scott Morton

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I. Introduction

The modelling concepts we have talked about in Chapter 2 and the new forms of technology we discussed in Chapter 3 must both be applied in a disciplined way to the Decision Support System problem area in a given organization. This means that there must be an organized, well understood design process by which such Decision Support Systems are implemented. Such a design process lies at the heart of successful application of this new approach in supporting managerial decision making. Unfortunately, due to the fact that we are in the very early stages of the application of this new field, such a design process cannot be talked about in a thoroughly detailed and completely understandable way. Therefore, this chapter does not contain a complete "cookbook" approach to the design and implementation of such systems, but it does give the major steps in the process and the important things that must be dealt with if such applications are to be successful.

Despite the fact that the design process cannot be talked about precisely and unambiguously, there are several things which are clear and must be well understood. The first of these is that the design process is not a linear sequence of steps, but rather, a cyclical, highly iterative process. As can be seen from Figure 1 (page 1a), the process has been

represented as circular. The question of exactly which cell in which to begin the process is not a major question as long as one operates with the decision rule of going through the entire process at least twice before starting detailed work. For example, some people prefer in designing such systems to start with the objectives for the relevant level of the organization and move from that to a description of the current decision process. Others prefer to start with the current decision process and move on from there. Neither of these is right or wrong, the point is that as long as one proceeds down through the evaluation stage and back up to objectives at least twice then, in fact, all of the stages have been covered, and it does not matter which one begins the process. It is impossible in Figure 1 to draw all the arrows that come back from each of the boxes, but in no sense is it either necessary or desirable to deal with any one of the boxes first in its entirety and then move on to the next stage, one is constantly oscillating between each and every one of the boxes. For reasons of exposition, it is necessary to identify each of the steps as a separate and distinct step, it should be made as clear as possible, however, that the steps do merge together, and one continually moves back and forth between the various stages. It is then a cyclical process and not a linear sequence of steps.

The second point that should be raised about the design process for decision support systems is that it is very

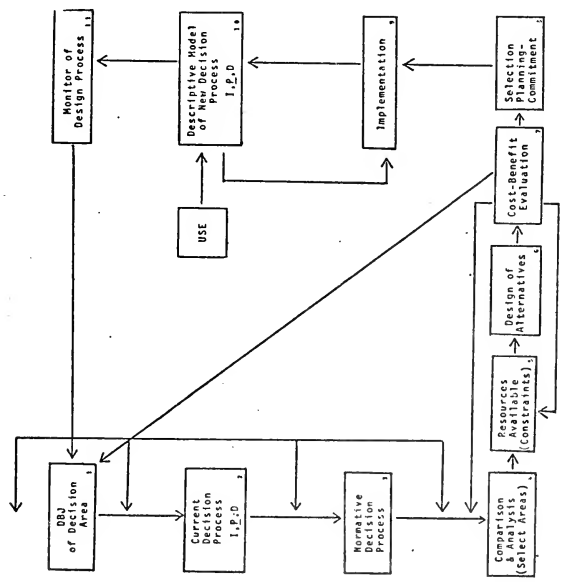


Figure 1

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hierarchical. This point is discussed more fully later, but the essential feature that must be clearly understood is that the design process goes on at various different levels in the organization. The process is basically the same at each level, but the decision and the people that are involved will differ as one goes down the organization. Thus, for example, one could worry about the critical decisions for the organization and decide that they fell in the marketing area over the next five years and then go through the decision support systems design process in the marketing area and decide that without marketing the crucial decision was in a particular area, say, new product decisions. Thus one starts at a broad level at the top of the organization and progressively narrows the focus until one has arrived the organization's most critical decisions, the decisions for which support systems will be built. Starting with the preconceived notion of which decision is important, or starting to work with the executive who is making the most noise and causing the most disturbances and similar sorts of practices all lead to the likelihood of an incorrect focus of the efforts of the staff. This point is extremely important, not so much because of the possibility of wasting money, but because the opportunity cost is so high. For example, a recent study¹ show the following numbers:

If a computer department's budget was say \$300 in 1969 then \$100 of that would be spent on hardware

¹Boozé, Allen and Hamilton.

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and \$200 of that would be spent on software and people in the average installation. Of the \$200 spent on people, approximately \$30 would be spent on operations, that is, running the machines, looking after the tapes and so on. The other \$170 would be spent on maintenance, that is, installing and modifying the existing programs. \$40 would be spent on the development of new programs and approximately \$10 on miscellaneous items. Therefore, out of the entire computer department's budget, only about 13% is available for new program activity.

In fact, the numbers are considerably worse than this because let us assume that most new projects take on the average two years to complete. This means that of the \$40 available for new programs, only \$20 are actually available to be committed in this year, because \$20 are already committed to complete previous projects. Therefore, in fact, for many organizations only 7% of the entire computer budget is available in a discretionary fashion to start any new activities.

As the numbers above show, the question of focusing on the right problem is extremely important, because the funds available are limited. This means that if the wrong project is picked, it will be some number of years before the organization is able to turn around and address themselves to the correct problem. This happens continually in traditional information systems and is no less true in the decision support area. To minimize the possibility of this happening, it is important to treat the process as a hierarchical one, and therefore, be as sure as possible that the final problem that is addressed is in fact a relevant problem.



The third major point that can be made is that this decision support design process can usefully be applied within each of the six cells discussed in the framework given in the Introduction. As was discussed there, the focus of the systems is on support for decision making. Since decisions are made throughout the organization, it becomes necessary for practical purposes to break down the decisions and categorize them in some fashion. We find the broad categorization given in the Introduction to be a useful one for decision support systems. The attempt in the design process is to clearly identify the critical decisions for which such support systems can usefully be built. This design process then can be applied to both the structured and unstructured types of decisions and in operation control, management control and the strategic planning areas. It will turn out, of course, that only a small subset of the decisions that are analyzed will justify the use of a decision support system of the kind we are talking about in this book. That is, many structured decisions can be dealt with via hatch computer systems, and fully unstructured decisions may not lend themselves to any economically feasible computer support. Regardless of the system ultimately built, the design process discussed in this chapter is applicable.

The analysis, the models, and the technology must be brought together in a design process that allows them to be applied to real problems in a real organization. Although we cannot

at this early stage in the development of such systems be as precise as we would like on the design process itself, it is clear that the three points we have mentioned above are central issues to be understood by any organization.

Importance of Explicit Models

A second major issue that ought to be raised before talking about the specifics of the design process is the necessity of having an explicit model of the process itself. This is doubly important because the process is poorly understood at this point in time. Therefore, one of the major reasons for having an explicit "model" of the process is so that it can be well understood by the organization using it, and therefore, that it can be modified at a future point. In other words, by having an explicit model with the stages identified, it is then possible to look at this model twelve months later or at the end of the project and discuss how it might be modified to be made more effective for subsequent use. If the model is left implicit, that is, in the project manager's head, then it is hard to make it clear what is involved in the remainder of the organization and very hard for that manager himself to understand which stages might be modified for the next task. Organizations have historically been reluctant to do this with the traditional information systems area, and this has caused difficulties in a number of organizations. In the field of decision support systems, the luxury of allowing the whole process to be intuitive cannot be afforded.

A second major reason for having an explicit model is that there are different people involved in each of the different stages. Unlike the design and implementation of traditional information systems, the roles of the senior managers, and the line manager who is the user, are much more dominant. The line manager must be actively involved in the design of the system that he is going to use. Similarly, senior managers must be actively involved in the process of narrowing the focus as to which decisions are to be implemented. There is no way in either case in which these decisions can be delegated to staff or systems analyst personnel. The question of who should be involved in each of the stages is discussed in detail below, and it is important for the organization to recognize the time commitments of the various types of people that are involved. This is particularly critical in the Decision Systems Support area, because the roles for the traditional systems analysts, that is those analysts who have grown up with batch-processing computers and traditional applications, such as Accounts Receivable and Inventory Control, are not the types of analysts that are involved even in the technical phases of the Decision Systems Support area. The involvement of the correct people at the correct stage of the process is a crucial reason for having an explicit model of the process.

The third and final reason for having an explicit model is to allow the senior managers involved to set up the timing and the plans for the implementation of such a system based on

these various stages. That is, the steps in the process discussed in Figure 1 can be organized on a time frame that allows a certain period of time to each of the stages; and when people are mapped on top of this, it permits the development of a plan to which people can be held. This ensures that the project is undertaken in a disciplined and methodical way and that management will know when to expect results and can take appropriate action if these are not forthcoming. The ability to develop explicit plans and control against them is a direct function of the availability of an explicit model of the design process.

Therefore, we are asserting that it is of the utmost importance that each organization have an explicit model of the design process and that this should be used as a basis for both planning and control of the process itself and for the actual design and implementation of the systems that are to be used to support managers.

II. The Design Process

Figure 1 represents a simplified version of our view of the design process. This is a view that has evolved over time as we have built and installed a number of such systems in ongoing organizations. For the purposes of this book, it is not appropriate to go into great detail on each of the steps. However, it is useful for all those involved in this area to have

a general understanding of the major steps that are involved so that they can be sure that their organizations move towards an explicit, formal representation of this process. This will allow the process to become common to the organization so that everybody understands the steps that are involved and who should be involved in them. As will become clear below, each step does involve a different methodology, different kinds of tools, different sorts of people and must be well understood if it is to be managed and successfully implemented. This brief rather abstract version of the design process will be expanded on through the use of an example in the material that follows this section. This should allow some clarification of the issues that are involved. It is important to recognize, however, that by its very nature this semi-structured decision area does not lend itself to the development of prewritten software packages. The focus must be on the analysis of the major critical decisions and the construction of a system to support those. It is most unlikely in this early stage of development that we will understand enough to build general purpose software packages that can be brought in and applied without the analysis that is discussed in the material that follows. This is an important point and has a number of implications for the purveyors of interactive software packages.

1. Objectives

In building Decision Support Systems (DSS), it is extremely important to specify the objectives of the decision area. As has been discussed above, this decision area could be that of the overall organization or it could be some component of it. For example, in the terminal-costing section discussed in Chapter 5, let us say that the objectives of the overall organization were a certain profit margin and a certain increase in growth in profits. Upon analysis, it might become clear that the critical thing for that company, given these objectives, was the prices which they quoted on their bids. This might be the key to their profits. Specifically, they would develop a percentage profit margin which they wished to achieve on average, and a percentage increase in profits. These specific numbers would form the operational objectives, and the bid-pricing is the decision by which these objectives are to be reached. The next level of the hierarchy is obviously to specify some specific sub-objectives for the bid-pricing decision. These particular sub-objectives then become the criteria against which various new system design alternatives are matched in order to decide which system will do the best job on the pricing problem.

These objectives then are hierarchical, and one must start at the overall level first. After this has been dealt with, one then moves to the various production, marketing, and controller area objectives. Each of these sub-areas will, in turn,

effectiveness, it is particularly important to have the objectives clear. Without clear, explicit, operational objectives, it becomes almost impossible to conduct a decent cost/benefit study in later stages of the process. This operational specification of objectives is extremely difficult--not because of the inherent difficulty, but because of the unwillingness of most managers to face the problem squarely.

Given the above discussion, it is clear that it is the senior managers at any given level who must be involved in the specification of objectives for that level. For example, for overall company objectives, the Board of Directors, the President, and his executive vice presidents must be the ones who specify the objectives. If the next level that is focused on is marketing, then the senior Marketing Vice President and his line managers at that level must be involved in the specification of the objectives for marketing. In each case, once the objectives should be stated explicitly, and they should always be reviewed carefully and critically by the managers one level above. That is, the President and other executive vice presidents would review the marketing decisions and the Board of Directors review the organizational objectives. This specification of objectives is not a task that can be delegated to staff or junior managers, it is the clear and unmistakable responsibility of the senior managers involved. Since senior line managers must make this statement of objectives, they are in the final analysis, responsible for the appropriateness of the

have particular sub-objectives, and within each of those there will be sub-sub-objectives, and so forth down the hierarchy. This first step in the design process then has to do with the explicit specification of the objectives of each of the levels.

This process is difficult, fuzzy, and very intuitive. Hence, managers in almost all instances tend to avoid it where at all possible. The objectives certainly exist, but they tend to remain implicit and not to be brought to the surface and stated explicitly. The human decision maker likes to avoid ambiguity; and the well-known "Gresham's Law" can be stated as structured work tends to drive out unstructured. This is certainly true in relation to the explicit specification of objectives. The difficulty is, of course, that it is not enough to state the objectives in a vague sort of way, but they must be stated operationally; that is, they must mean something to the managers who are to work with them. That is, of course, extremely difficult to do, and very few organizations can claim to have usefully stated, operational, goals. However, if this is not done, then Decision Support Systems are of little use. The small amount of discretionary resources and the large investment of managerial time places a premium on being clear as to the goals that are to be met by such a system, since with Decision Support Systems we are talking about improving the effectiveness of a decision, not the efficiency of the process by which it is made. Since we are focusing on

Decision Support System. Failure to implement an appropriate DSS is, therefore, their responsibility.

There is no magic process by which to specify objectives. It is first and foremost an intuitive, experimental process. The important point is that it should be a written document, written by the senior managers involved, and it should be a document that is open for discussion by the relevant groups. There is no formula by which this can be done. Objectives do exist informally; the issue is to get them down formally, and thereby, increase their usefulness to the organization. This means the senior level involved specifying explicitly what they feel the objectives are at an operational level, and the level below them discussing these and suggesting modifications. When this iterative process is completed, both levels commit to the explicit statement of objectives.

2. Current Decision Process

The next step in the decision systems design process is a "model" of the current decision process. The use of the word "model" here does not normally mean that any mathematics is involved. What we are talking about is an explicit verbal statement of the sequential steps that are involved in making the decision that is being looked at. If relations can be expressed in mathematical terms, then that is a simpler way of doing it than writing it all out in longhand, but the emphasis is on a description of the way the current decisions are being

made. It is frequently convenient to talk about these major factors in terms of input, processing and output. That is, the output is the decision that is being made, the processing is the manipulation, comparison and evaluation of the information, and the information, of course, is the information required to make this particular decision.

Perhaps the simplest way of making this point clear is to give a simple example. In Chapter 5 we discuss a cost-accounting system designed to help the Executive Vice President of a particular company in the pricing for his major bid decisions. Figure 2 represents a simple descriptive statement of the decision process that existed before the development of the new system. This figure is largely self-explanatory, but on the one hand, he had access to the standard cost-accounting system's development of a direct and full cost which was then modified by the accounting department to reflect the special conditions of this particular bid request. They then added to this modified standard cost a profit margin that reflected the organization's goals. The Executive Vice President has in the meantime access to all his normal informal information, and this consists of recent activity by the competition, his expectations of competitive action, the expectations for sales level and production of his own organization and the profit picture and his future expectations of it. All these informal pieces of information are then used to modify the "price" that he has received from the system, and he develops a new price.

This is then tested with the relevant senior managers involved, which may be the controller, or the marketing manager, and so forth; and if it is acceptable, then a bid is made at that level, if not, the process is reiterated several times.

This then is a very rough descriptive model of the decision process on a bid decision in this particular organization. It can be divided into input, processing and output. The input are all those boxes on the top and to the left of Figure 2. The processing is the modification of the price, and the output, of course, is the bid price itself. Before moving any further with this particular decision, this rough model would have to be taken and expanded in considerably greater depth before any analysis could be made. Nevertheless, this is the sort of effort that is meant in this instance by a description of the current decision process.

It is important to recognize that the so-called management information systems area has traditionally been largely concerned with the input and the output of these decisions. Very little, if any, attention has been paid to the processing part, that is, the decision-making aspects of the decision.¹ In the Decision Systems Support area, we are concerned with all three, and perhaps we are most concerned with the decision process itself. This means, then, the development of models to support the decision process as we discussed it in Chapter 2.

¹See Gorry () for a full discussion of this issue.

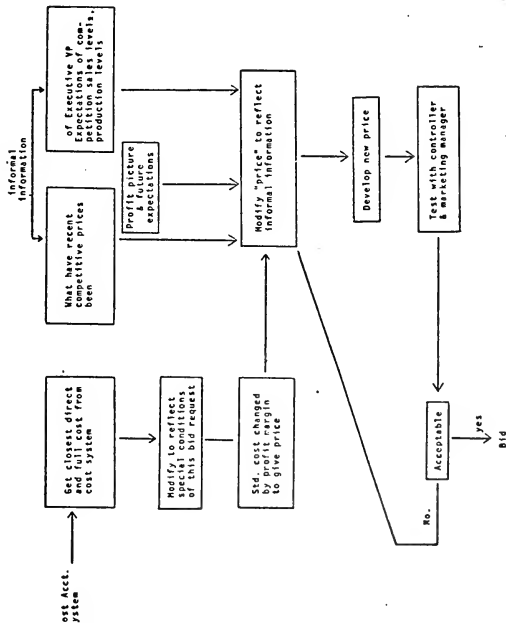


Figure 2

The people involved in this stage of the decision systems design process should be the systems analysts and the staff. Given that senior management has focused the attention on the particular decisions that are important, the systems analysts and the staff in the functional area concerned can then do the kind of descriptive modeling represented by Figure 2. This descriptive model must be subject to line management review. The line managers have, of course, particularly heavy inputs in the decision process part of the description, but in addition, they should agree and understand to the nature of the model that describes that decision.

The methods and techniques of doing such descriptive modeling are not dissimilar to the kind of systems analysis that has been employed traditionally in the management information systems field. The focus in this instance is on a particular decision, and that is the starting point for the analysis. From this decision, the analysis should work backwards to the processing that goes on and the information that is used in the processing. By moving backwards from the decision, as opposed to starting from all possible information that flows into the decision, it becomes easier to separate out the information that is actually used for the decision versus the information that is potentially available. However, for our purposes here, we can regard the process as substantially the same as that used in good, traditional systems analysis work.

3. Normative Model

The next stage in the decision systems design process is the development of a normative model. This is a statement of the way the decision ought to be made. Given the objectives of this particular decision process, what should it look like if the decision is to be made in the best possible way. This is looking for the theoretically correct way of doing all three of the stages of input, processing and output. The use of the word normative is a little misleading in the sense that there is no way of proving that any particular method is ideal or optimum. Nevertheless, in this stage one ought to be striving to get as close as possible to the ideal. The modeling effort involved here is the same sort of thing as was involved in the stage above, that is, the descriptive modeling. Given the decision in question, what is the theoretically best method of solving that particular decision. This does, of course, imply the right decision is being examined in the first place.

The people that are involved in this critical step are the staff from the line area involved--if it is a production area, then the production manager's staff; if it is a marketing area, then the marketing manager's staff; and if these are not available in the local division, if it is a large company, then they should be made available from the central headquarters. In addition to staff from the line area, the line managers should be involved to the extent that they are both interested and qualified. The other persons that might be involved are

consultants, experienced professionals and academics. Each of these last three groups are likely to be familiar with the literature and will have seen a large number of other companies and the methods by which they solve this decision. In almost all instances, there will be no complete theory on which to base any such normative model, but rather one has to rely upon the guidance of experts in the field and what little theory exists. One wants to remain as open and flexible as possible to build upon whatever theory is available and rely upon the wisdom and experience of those familiar with the field. This is the most difficult and creative part of the whole decision systems support area. It is difficult to do, very unsatisfactory to talk about and crucial to the ultimate success of the overall operation. Despite this difficulty, there is no way of avoiding this step in the process as such normative modeling goes on even in the most informal suggestions for changes to existing information systems. Each manager or professional in his field has his own ideas of the "correct" way of making a particular decision. This step makes these explicit and allows experienced men to discuss the relative merits of various suggestions in arriving at the final version of the normative model.

4. Comparison and Analysis

The comparison of the current decision process with the normative decision process yields an identification of gaps between the two methods of making the decision. Given the objectives,

the contrast between the current decision process and the normative decision process when analyzed carefully yields the criteria for the design of alternatives to improve the system. In short, it results in the accurate bounding of the problem. The derivation of the complete specifications for the new system is "problem finding" in the complete sense of that expression. This comparison and analysis will, of course, result in iteration through earlier parts of the process such as redefinition of objectives, more careful modeling of parts of the current decision process and perhaps more exploration of certain aspects of the normative decision process.

The staff and decision system support analysts who are primarily involved in this stage will have to be strong enough in their personalities to go back to the various managers involved and ask them to rethink or more completely specify some of the material they have worked on earlier. The output of this stage is, of course, reviewed by relevant line and senior managers.

This process of analysis involves taking the decision process descriptions and first comparing their overall structure, that is, the overall decision process and its major stages. The second step is to take the specific point-by-point items in the categories of input, processing and output and look to see which items of information are missing, when comparing the normative with the descriptive, where intuition is being used, whether there are explicit models available, where

certain information is too slow or too inaccurate to be of much help and so forth. The output of this process is a clear definition of the gaps between the way the process ought to be and the way the process is currently being done.

5. Resources

As a practical matter before any significant effort is spent on the next stage of the process, namely the design of the alternatives, it is necessary to have a rough idea of the resources that are available for this particular decision support system. These resources will consist of people, particularly decision support analysts, regular systems analysts, and, of course, programmers. Also included will be a dollar budget for computer time, and perhaps, the most important, a commitment of line managerial time for the project involved. This list will be initially at least just a rough guide, a set of constraints under which the project should work on its initial iteration of the process. Clearly, if a particularly good idea is developed that requires extensive expenditures of money, then there always exists the option to go back and request more funds and hire more people. But even for particularly good ideas, in any given time period, there always exists a realistic level of resources that are operationally available. The marketplace may not allow you to hire more people, a delay in hardware availability may limit you for a year or more, and the education of the line managers may not be enough to use them actively in the project. This is,

therefore, not an absolute set of final constraints, but an idea of the kinds of resources that are likely to be available over the time horizon of the decision systems that are being examined.

This list of resources available should probably be drawn up between the controller, the senior management involved and the decision system support specialists who understand the kinds of "people talents" that will be required.

6. Design of Alternatives

Given the definition of the problem that has been accomplished in the first four steps discussed so far, there then exists the problem of designing various different alternative ways of solving it. A series of gaps were identified, and what is needed now is a set of strategies by which these gaps can be closed. These are major design alternatives at the level that considers various different solutions, such as a manual solution, the use of a whole range of computer techniques, perhaps alternatives that range from the use of interactive display terminals all the way through to modifications of the existing batch, tape-based systems. This process does not make computer recommendations; it is much broader than that and thinking of the problem in its broadest terms, designs major alternative strategies which might be solved.

Clearly, if the problem is defined well, then the correct solution is much easier to find, but it is a highly creative

process. This means that there is no simple way by which these alternatives can be generated. The use of decision support systems staff, as well as the active involvement of the line managers responsible for making the decision is a combination, that if they engage in an appropriate dialogue, can often generate a creative alternative. Consultants and systems analysts are also capable of providing design alternatives in this phase. It is important in this stage to keep these design alternatives at a highly aggregate, rough level so that teams do not get bogged down in detail. The emphasis on this stage should be on the generation of a wide range of feasible alternatives.

7. Evaluation

The evaluation stage is involved with a rough cost/benefit or cost-effectiveness analysis. It takes the alternatives generated from the previous stage and develops both an estimate of the costs and an estimate of the benefits to be derived from installing that particular alternative. As a result of this evaluation, there is likely to be iteration back to the stage of comparison and analysis and also iteration to the development of the resource constraints. Given this small loop of the last three boxes, it is cycled through several times. In addition, once one or two serious alternatives have been evaluated, it generally proves advisable to go back to the objectives of the decision area and cycle through the first seven boxes again. This major iteration is particularly important

if this first pass has been done in a rough-and-ready fashion and is also important if the process has been started at some place other than the objective-setting one.

The personnel involved in this evaluation stage are the line managers with responsibility for the decision, with assistance from their staff and careful prodding from the decision systems support professionals. The costs in decision support systems are usually not too hard to develop, although one has to be careful to include all of the relevant costs, and it is difficult to put a price on the managerial time involved.

However, by and large the costs are not difficult to develop. The benefit side, however, is extremely difficult to estimate. Benefits can, of course, immediately be broken down to both hard, tangible benefits and the softer intangibles. One approach that we have found beneficial is to separate the hard costs, such things as the reduction in computer time and paper costs through the discontinuance of old reports, or the sharp reduction in the amount of managerial time involved for the decision. With the remainder, it is often useful to take these and look at the percent of improvement in the decision that would be required to provide a payoff. For example, if there is a \$300,000 one-time cost of which \$100,000 can

clearly be attributed to tangible benefits, that leaves a \$200,000 residual. If we are talking about an inventory decision, for example, it can then be calculated how great an improvement in the level of inventory or number of stock-outs

must be achieved in order to cover that \$200,000 cost. If this number turns out to be very high, for example, inventory levels have to be reduced by a factor of 70% in order to accomplish this \$200,000 saving, then clearly it may be most unlikely that an improved decision will yield this kind of savings. On the other hand, if a very small percentage improvement in the inventory decision will yield several million dollars savings, then the balance of the intangible costs could reasonably be said to be met. The next and most important stage in the cost-benefit analysis, however, is the predictive mapping of the new decision process. That is,

given the decision support tools that will be available, what is the staff's expectation of the decision process the line manager will now use to make the decision. If the structure of this decision process, the kinds of information that will be made available, and the sorts of models that the decision maker will have to draw upon--if all of these are significantly different than the current system--then it is reasonable to assume the decision process will change. The manager will then have to decide whether this changed decision process justifies the balance of the intangible costs.

At this stage of development, it is probably fair to say that if there is not an overwhelming indication that a significant difference is likely in the quality of the final decision, then it is doubtful if it is worth proceeding. However, in most of the organizations with which we have dealt, there

have always been a number of decisions which could yield dramatic improvements in the quality of the decision if the decision maker had been given some adequate support. This several-step process of evaluation is not in any way a guarantee of selecting the correct alternative. It is important, therefore, that this decision be embedded in a planning and control system that makes the manager who is going to derive the support from this system pay for it. That is, if this decision is a real one for the manager involved, and if the money for the development and running of the system comes from his budget, then he is likely to pay a great deal more attention to the cost/benefit study than he would otherwise. In our experience, the existence of this macro-planning and control system has a significant impact on the motivation of the line managers involved and the quality of the final product.

8. Selection, Planning and Commitment

This stage in the process involves the three characteristics of selection and planning and commitment. The selection process has to do with both the selection of the decision that is to be supported by the decision support system and with the strategy by which this decision is to be supported. The choice of the critical decision, of course, comes first and the next level of selection is the problem of which strategy to use in its solution.

Commitment is the third of the activities at this stage and is perhaps the most important. The line managers involved must commit clearly and unambiguously to the objectives of the system, and the senior managers involved must commit to the resources required and to the implied significance of the decision. The major difference between decision support systems and traditional management information systems at this stage is that, in fact, the line manager is committing to help in the construction of the system as it is designed to support one of his critical decisions. This is a different level of commitment than he would give for support to an operational control information system, let us say, to do inventory control or accounts receivable. Senior management are clearly involved in the approval of the selection and in the commitment phases. The line managers are involved in all three of the commitment, planning and selection processes; whereas, the staff and analysts are involved largely in the planning and support for some of the selection activities. However, it should be clear that the line and senior managers must dominate the selection and approval process that is involved at this stage.

9. Implementation

The implementation process is, of course, concerned with writing the programs and putting up the system that is to support the decision. In this book, of course, we are concerned only with the implementation of interactive decision systems,

although as we have pointed out before, this method of analysis could well lead to a decision to implement some form of manual or batch-processing computer-based system. The details of implementation are largely technical and not, therefore, within the purview of this particular book. However, it is absolutely crucial that the implementation process be monitored carefully and consistently by the managers involved. The planning process left a master plan with milestones and specific forms of output. This will not be an effective control system unless it is actively used by the line manager who is responsible. In this sense, the implementation process is very much the responsibility and problem of the line managers involved.

There is also a second major sense in which the implementation process is an important part of the line managers job. As opposed to the traditional management information systems, we are dealing here with a system to support a particular managerial decision. The person best able to provide most of the input on the information, the models that should be involved, and the forms of output that will prove useful is, of course, the line manager who makes the decision. In this sense, the implementation process will inevitably involve the very close cooperation and participation of the line manager involved. There is no possibility of building one of these systems with the line manager staying removed and just using the final product. In our experience so far, the implementation process

has involved very heavy participation by staff and systems analysts and programmers to get a first working prototype system up and running. Once this system is built and usable on a pilot basis by the line manager, then he is able to react to the system as it stands and can provide his insights to the problem. His reactions, suggestions, and insistence upon change will result in a second stage of incremental changes that will allow the system to evolve until it becomes a useful, operational managerial tool. This evolutionary movement towards the final working system means that considerable care has to be paid to the software architecture, and the hardware implementation on which the system is based. Once the system has settled in and is being used on a regular basis, there will then be a series of incremental changes as the user begins to understand his problem more thoroughly and perceives the need for further change. As was discussed in the introduction, this is perhaps one of the most powerful features of the decision support systems, as they do provide the manager an opportunity to think about, and watch himself go through, his decision-making process.

On the one hand, the detailed hardware and software implementation process is not the concern of the manager, but rather the concern of the staff, the analysts and the programmers. On the other hand, the control of that technical implementation process is in his hands, and furthermore, he has a large and significant role to play in the implementation of the

overall system, since it is designed to support his decision making and therefore only he can provide the necessary managerial inputs.

10. New Descriptive Model

After the new decision support system has been installed and settled down, it is then crucial that a new descriptive model be built of the decision-making process that now exists with the new system. The methods of doing this descriptive modeling are exactly the same as they were when this was done under the old system, that is, a careful statement of each of the steps that are involved and a clear understanding of the input, processing and output that goes on in the course of making the decision. The importance of this step cannot be overemphasized as it forms the basis for the cost/benefit study and allows the managers involved to match progress clearly with the expectations at the beginning of the project. It is this comparison that provides the learning and generates the new ideas for future projects, as well as clarifying how cost effective the system was.

This new descriptive model has to be compared very carefully with the old descriptive model. Not just by looking at changes in the information inputs or in the nature of the final decision, but also very clearly and carefully at the changes in the nature of the processing that went on during the decision. Did the managers consider more alternatives

before arriving at the decision, did they make use of models which had some optimizing characteristics, did they look at more alternatives or more relevant information, and so forth, and so on. The way the decision process changed is the key to understanding the cost/benefit picture.

This is a difficult stage of the process to accomplish because a long time will have elapsed since the project was started in many instances and people are notoriously poor at going back and looking at the original objectives and making comparison as to how well they have been achieved. Difficult though it may be, it is one of the most important steps in the entire process.

11. Monitor of Design Process

In the introduction to this process model, it was pointed out that in fact the state of the art in the design process area is very weak. The model we have sketched very briefly here is only a simplified version of the real world, and we simply do not understand enough of the details of this process at this point to provide a certain way of achieving successful implementation of decision support systems. For this reason, we advocate a clear discussion within an organization of the model we have described here, and more importantly, its adaptation to the organization concerned. However, at the end of each decision support system project, it is important to go back to the organization's current model of the overall design process and see whether or not it should be adjusted. It

might be adjusted by specifying different people in the organization to participate in each of the different stages, it might be modified by inserting more detail at some of the stages and dropping out others, or it might be left roughly as it is. In any event, this monitoring of the design process as it was used to implement the decision support system is an important part of the overall process. If mistakes have been made, they can frequently be traced to inadequate implementation of some of the steps and similarly if a decision support system has been very successful, it is extremely useful to analyze why and try to make sure that future projects are implemented in the same general way. Like all the stages in this process, this particular one is difficult, and again, is executed very rarely with traditional information systems, but once again, is important in the use of management decision systems.

III. Hierarchical Nature of the Design Process

The decision systems design process as has been discussed above is a simple version of what has to go on in each organization if any one of the systems that are described in the following chapters are to be implemented. As was pointed out in the beginning of the chapter, it is a very hierarchical process, and it does assume in the diagram of Figure 1 that one is at the correct level in the organization. This is an unrealistic assumption, and one of the most important activities is to be sure that, in fact, the organization focuses its attention on

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the most critical decisions. As was suggested above, this means that the organization must iterate through Boxes 1 to 7 several times, each time at a different level. Figure attempts to illustrate this in diagrammatic form. That is, assume that the design process begins at the level of the total overall organization. It moves through the stages of objectives setting for that organization. The current decision process that achieves those objectives, the normative model, the comparison process, and out of this comparison process in Box 4 (see Figure 3) comes the observation that marketing is an extremely crucial part of the organization and one in which there is a significant gap between the current decision process and the normative decision process. With this marketing area in mind, the design of alternatives is entered and the evaluation stage following that. In the evaluation stage, it turns out, perhaps, that marketing is indeed an important area and that there are several possible strategies that might be used to support the marketing decisions. If this is not clear at this stage, of course, then the process is cycled through once again, and we move back up to objectives. However, if it is clear, then we drop down one level further and start with the objectives of the marketing decision area. We then look at the current decision process on the key objectives in marketing and move down through the steps again, perhaps coming out of the comparison process in Box 4 (at the second level) with the notion that the critical aspect in the marketing field is to have the right product delivered on time.

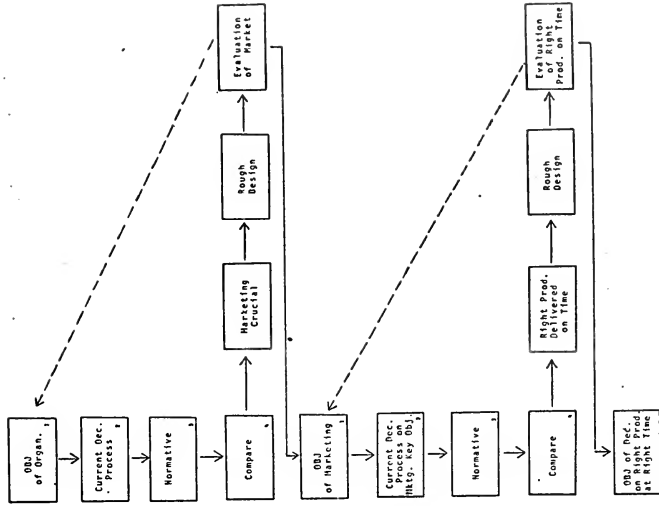


Figure 3

After design and evaluation, it turns out that there are several possibilities for improving that part of the decision process, and one drops down one level further to look at the objectives of the decision to produce the right product at the right time.

From this simple example, it is clear that one is moving down the level of the hierarchies, becoming more specific at each stage, but each time one drops down a level, one does so only after explicit consideration of a wide range of alternative decisions in a variety of different areas. At the first level in Figure 3, marketing was presumably competing for attention with production, control and legal services, and so on. This constant focus and refocusing is an important characteristic of the design process if it is to be successful. In many organizations, this initial screening is done on the basis of which executive can attract the most attention, or the backgrounds of the systems analysts who happen to be working in the field, or just perhaps the predilections of the senior officer involved. Given the very few discretionary resources that are available to an organization to start a new system such as this, this ad hoc kind of settling on an area is an unsatisfactory process.

